

ENVIRONMENTAL MONITORING OF SALMON AQUACULTURE

by John Sowles – Director, Ecology Division

Every finfish farm in the state of Maine is monitored for compliance with Maine's water quality statutes and requirements of the federal Clean Water Act through the Finfish Aquaculture Monitoring Program (FAMP). The program was established in 1991 by the Legislature and funded by a finfish industry production tax. This program is unique in that it annually monitors the environment in which finfish aquaculture operates using an independent third party contractor hired by the DMR. MER Assessment Corp., of Brunswick, has the current contract. This is in contrast to virtually every other discharger in Maine, whose DEP permit requires "self-monitoring," collecting and submitting their own data to the State. Although self-monitoring is a reasonable and effective means of determining compliance, the independent aspect of FAMP has some advantages. Because one contractor is responsible for all data collection across the entire industry, assessments are uniform. This enables us to compare data across all operations without concern that one or another used a different method. Secondly, because it is our responsibility, we continually know the status of testing and whether or not immediate remedial action is warranted, even before the formal monitoring reports are submitted. Thirdly, we are able to respond rapidly to advances in monitoring technology and have done so over the past 13 years of the program.



Finfish Aquaculture Monitoring Program equipment.

Since 1991, we have gathered over 1,500 water quality profiles (a profile consists of literally hundreds of dissolved oxygen, salinity and temperature readings over many depth intervals),

over 1,000 bottom sediment cores to determine the resident biological community in the vicinity of the pens, and over 318 hours (~13.5 days) of video footage under and around the fish pens.

What Monitoring Takes Place?

Every fall, when salmon biomass, feeding, and water temperatures are at their peak, our contractor visits each and every active farm to monitor dissolved oxygen in the water and record video transects under and around the pens to assess general health of the bottom.

Oxygen is measured from the surface to the bottom at the down current edge of each pen system. These measurement assure us that oxygen consumption inside the pens by the salmon do not cause oxygen levels outside the pen to be unfit for wild fish. Oxygen up current and 100 meters down current from the pens is also measured to understand the impact the pens are having on ambient oxygen levels.



Finfish Aquaculture Monitoring Program Leader, Jon Lewis, taking dissolved oxygen, salinity and temperature readings at one-meter intervals from the surface to the bottom adjacent to a salmon farm.

We also record video footage of the bottom beginning at a point 60 meters away from the pens and continuing toward, under and 60 meters beyond the pens. The diver notes anomalies and conditions including fallen nets, buildup of feed, feces, or organic matter and any release of gas from the sediment. Upon surfacing, the diver reports his or her findings immediately to the farm operator regardless of conditions. If adverse conditions are found, our contractor informs the DMR of these conditions.

At all sites where concerns are identified in the fall survey, the DMR notifies the site operator and requests remediation. The following spring, an inspection and video transects are made to ensure that those concerns have been addressed. Additional sites are also inspected as resources permit. Until recently, most all sites were visited twice each year.

Since visual cues may not always identify adverse conditions, especially within sediment, a more detailed inspection is conducted every other year, regardless of condition. Bottom cores are taken along the transect at 60, 30 and 5 meters distant from the pens. The sediment is sieved through a 1 mm mesh screen and the marine life identified and counted. Table 1 is an example of the results one such survey. From this information, we can determine whether or not the bottom environment is significantly different from surrounding natural areas.



Finfish Aquaculture Monitoring Program diver extracting a core of sediment below a salmon farm for analysis of benthic infauna.

Table 1
Example of Benthic Community Analysis at a Salmon Farm

MER ASSESSMENT CORPORATION BENTHIC ANALYSIS REPORT							
DATE	10/14/1998						
LOCATION	CONACP1INSIDE						
NO. SAMPLES	3						
	SAMPLING STATIONS						
	Sp. Cat.	1	2	3	Total	Mean	SD
ANNELIDA							
POLYCHAETA							
Capitellidae		0	0	0	0	0	0
Capitella capitata	4	60	77	24	161	53.667	22.1
Cirratulidae	1	0	0	0	0	0	0
Chaetozone setosa.		4	0	0	4	1.333	1.89
Tharyx spp.	3	0	0	3	3	1	1.41
Nephtyidae		0	0	0	0	0	0
Nephtys sp.	3.5	1	0	0	1	0.333	0.47
Orbiniidae		0	0	0	0	0	0
Naineris quadricuspida		0	0	2	2	0.667	0.94
Scoloplos sp.		1	0	0	1	0.333	0.47
Pectinariidae		0	0	0	0	0	0
Cistena granulata		1	0	2	3	1	0.82
Phyllodocidae		3	0	0	3	1	1.41
Sigalionidae		0	0	0	0	0	0
Pholoe minuta	4	0	0	1	1	0.333	0.47
OLIGOCHAETA		11	7	4	22	7.333	2.87
MOLLUSCA							
Bivalvia		0	0	0	0	0	0
Modiolus modiolus		1	0	1	2	0.667	0.47
Mya arenaria		0	1	0	1	0.333	0.47
Mytilus edulis	3	0	0	1	1	0.333	0.47
Nucula spp.	4	1	1	0	2	0.667	0.47
Gastropoda		0	0	0	0	0	0
Acmea testudinalis		0	0	1	1	0.333	0.47
Buccinum undatum		0	0	1	1	0.333	0.47
Colus sp.		0	2	0	2	0.667	0.94
NEMATODA		7	24	17	48	16	6.98
NEMERTINEA		0	0	2	2	0.667	0.94
Total organisms		90	112	59	261	87	21.74
Abundance as No. organisms/0.1 m ²		1111	1383	728	3222	1074	268.39
Species richness (No. species)		10	6	12		9	2.49
Distance in meters		0	0	30			
% Capitella capitata		67	69	41		62	
Rel. Diversity		0.533	0.512	0.703		0.583	0.09

Who Reviews the Information?

The short answer is, anyone who is interested. Monitoring reports are prepared that include all the raw data, a summary, and recommendations for follow-up monitoring. These reports are public information and are available on request. More formally, the Interagency Technical Committee comprised of state and federal agency staff reviews the data and information. Represented are the Maine Departments of Marine Resources, Environmental Protection, Inland Fisheries and Wildlife, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, National Marine Fisheries Service and U.S. Fish and Wildlife Service.

In addition to reviewing the annual data, the members of the committee also periodically review the program and suggest revisions to improve it. The most recent review is due for completion in the spring of 2003.

What about emerging concerns?

An especially valuable attribute of FAMP is the flexibility to address new and emerging concerns without having to amend lease, permit, or license conditions, often requiring lengthy proceedings. Since 1991, we have addressed issues of eutrophication, accumulation of toxic contaminants in sediments, and green algal mats. These special studies help us determine the nature and extent of the concerns and whether additional constraint needs to be placed on the industry as a whole or on individual waterbodies.